

Amendments to the Claims:

1. (Currently amended) A method for the production of a sterically hindered phenolic alkyl ester compound, which method comprises:
- reacting methyl acrylate with a sterically hindered alkylphenol compound in the presence of a first catalyst to form a methyl ester intermediate compound,
 - reacting an alcohol having at least 2 carbon atoms with the methyl ester intermediate compound in the presence of a second catalyst to form the sterically hindered phenolic alkyl ester compound,
 - forming a precipitated phosphate salt by steps consisting essentially of
 - neutralizing any catalyst residue with an aqueous phosphoric acid, and
 - removing water to form a precipitated phosphate salt, and
 - separating the precipitated phosphate salt from the sterically hindered phenolic alkyl ester compound,

wherein said first catalyst and said second catalyst as charged to the reactor comprise at least one compound selected from the group consisting of alkali metal hydroxides, alkali metal alkoxides, and mixtures thereof.

2-3. (Cancelled)

4. (Original) The method according to claim 1, wherein the first catalyst is also used as the second catalyst during the reaction of the alcohol with the methyl ester intermediate compound.

5. (Previously Presented) The method according to claim 1, wherein the first and second catalysts comprise at least one compound selected from the group consisting of sodium alkoxides and potassium alkoxides.

6. (Previously Presented) The method according to claim 1, wherein the first and second catalysts comprise at least one compound selected from the group consisting of sodium hydroxide and potassium hydroxide.

7. (Previously Presented) The method according to claim 1 wherein filtration is used to separate the precipitated phosphate salt from the sterically hindered phenolic alkyl ester compound.

8. (Previously Presented) The method according to claim 1, wherein the sterically hindered phenolic alkyl ester compound is formed in a liquid form.

9. (Original) The method according to claim 1, wherein the alkylphenol compound is 2,6-di-tert-butylphenol.

10. (Previously Presented) The method according to claim 1, wherein the sterically hindered phenolic alkyl ester formed is a 3,5-di-tert-butyl-4-hydroxyhydrocinnamic acid, alkyl ester.

11. (Previously Presented) The method according to claim 1, wherein the molar ratio of methyl acrylate to alkylphenol is at least 1:1.

12. (Original) The method according to claim 1, wherein a molar excess of methyl acrylate is employed so that the molar ratio of methyl acrylate to alkylphenol is greater than 1:1.

13. (Original) The method according to claim 1, wherein a molar excess of methyl acrylate is employed so that the molar ratio of methyl acrylate to alkylphenol is between about 1.05:1 to about 1.30:1.

14. (Original) The method according to claim 1, wherein a molar excess of alkylphenol is employed so that the molar ratio of alkylphenol to methyl acrylate is greater than 1:1.

15. (Original) The method according to claim 1, wherein a molar excess of alkylphenol is employed so that the molar ratio of alkylphenol to methyl acrylate is between about 1.05:1 to about 1.30:1.

16. (Previously Presented) The method according to claim 1, wherein the phosphoric acid comprises at least one compound selected from the group consisting of orthophosphoric acid (H_3PO_4), pyrophosphoric acid ($H_4P_2O_7$), and metaphosphoric acid (HPO_3).

17. (Original) The method according to claim 1, wherein the molar equivalent of aqueous phosphoric acid used is between about 10% and 200% of the total amount of catalysts used.

18. (Original) The method according to claim 1, wherein the molar equivalent of aqueous phosphoric acid used is between about 33% and 100% of the total amount of catalysts used.

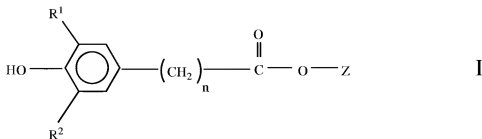
19. (Original) The method according to claim 1, wherein the alcohol is a high molecular weight alcohol.

20. (Original) The method according to claim 1, wherein the methyl acrylate is reacted with the alkylphenol compound in the presence of a promoter.

21. (Previously Presented) The method according to claim 20, wherein the promoter is at least one compound selected from the group consisting of dialkyl sulfoxides, dialkyl formamides, dialkyl ethers, N,N-dialkyl acetamides, methyl ethyl ketone, methyl butyl ketone, phase transfer agents, crown ethers, and mixtures thereof.

22. (Original) The method according to claim 20, wherein the promoter is tetrahydrofuran.

23. (Currently Amended) A method for the production of a hindered phenolic alkyl ester compound of Formula I:



wherein:

R¹ and R² are independently selected from the group consisting of H, alkyl, cycloalkyl, aryl, alkylaryl, and arylalkyl, where at least one of R¹ and R² is sterically bulky;

n is 2; and

Z is alkyl;

said method comprising the steps of:

a) reacting methyl acrylate with an alkylphenol compound in the presence of a first catalyst to form a methyl ester intermediate compound, wherein the alkylphenol compound is in accordance with Formula II:



and wherein R¹ and R² are defined as above;

b) reacting an alcohol having at least 2 carbon atoms with the methyl ester intermediate compound in the presence of a second catalyst to form the hindered phenolic alkyl ester compound having the structure according to Formula I, and

- c) forming a precipitated phosphate salt by steps consisting essentially of
i) neutralizing the catalyst residue with an aqueous phosphoric acid, and

ii) removing water to form a precipitated phosphate salt, and

d) separating the precipitated phosphate salt from the hindered phenolic alkyl ester compound,

wherein said first catalyst and said second catalyst are the same and comprise at least one compound selected from the group consisting of alkali metal hydroxides and alkali metal alkoxides, and mixtures thereof.

24. (Original) The method according to claim 23, wherein R^1 and R^2 are alkyl.

25. (Previously Presented) The method according to claim 23, wherein the aqueous phosphoric acid is aqueous orthophosphoric acid.

26. (Previously Presented) The method according to claim 23, wherein R^1 and R^2 are tert-butyl and wherein Z is butyl, isooctyl, or 2-ethylhexyl.

27. (Original) The method according to claim 23, wherein Z is C_2 - C_{20} alkyl.

28. (Previously Presented) The method according to Claim 23 wherein the hindered phenolic compound is 2,6-di-tert-butylphenol, wherein the alcohol having at least 2 carbon atoms is n-butyl alcohol, isooctyl alcohol, or 2-ethylhexyl alcohol, and wherein the first catalyst and the second catalyst utilized in the method is potassium hydroxide.

29. (Cancelled)

30. (Previously Presented) The method according to claim 23, wherein the aqueous phosphoric acid comprises at least one compound selected from the group consisting of orthophosphoric acid (H_3PO_4), pyrophosphoric acid ($H_4P_2O_7$), metaphosphoric acid (HPO_3), and mixtures thereof.

31. (Previously Presented) The method in accordance with claim 23 wherein as charged to the reactor, the second catalyst has the same chemical composition as the first

catalyst; wherein the first and second catalyst residues are neutralized with aqueous orthophosphoric acid to form a precipitated salt, and wherein said first catalyst and said second catalyst as charged to the reactor are the same and comprise potassium hydroxide or potassium alkoxide.

32-33. (Cancelled)

34. (Previously Presented) The method according to claim 20, wherein the promoter comprises at least one compound selected from the group consisting of dimethyl sulfoxide, dimethyl formamide, diethyl ether, diisopropyl ether, and mixtures thereof.

35. (Cancelled)

36. (Currently Amended) A method for the production of a hindered phenolic alkyl ester compound, which method comprises:

a) reacting methyl acrylate with a hindered alkylphenol in the presence of tetrahydrofuran and a first catalyst to form a methyl ester intermediate compound,

b) reacting an alcohol having at least 2 carbon atoms with the methyl ester intermediate compound in the presence of a second catalyst to form the hindered phenolic alkyl ester compound,

c) forming a precipitated salt by steps consisting essentially of

i) neutralizing any catalyst residue with an aqueous phosphoric acid, and

ii) removing water to form a precipitated salt, and

d) separating the precipitated salt from the hindered phenolic alkyl ester compound, wherein said first and said second catalyst are the same and comprise at least one compound selected from the group consisting of alkali and alkaline earth metal hydroxides and oxides, alkali metal hydrides, alkali metal alkoxides, alkali metal amides, alkali metal hydrocarbyloxides, and mixtures thereof.

37. (Original) The method according to claim 36, wherein the alcohol is reacted with the methyl ester intermediate compound in the presence of tetrahydrofuran.

38. (Currently amended) A method for the production of a sterically hindered phenolic alkyl ester compound, which method comprises:

a) reacting an alkyl acrylate with a sterically hindered alkylphenol compound in the presence of a catalyst to form the hindered phenolic alkyl ester compound,

forming a precipitated salt by steps consisting essentially of

i) neutralizing the catalyst with an aqueous phosphoric acid, and

ii) removing water to form a precipitated salt, and

separating the precipitated salt from the hindered phenolic alkyl ester compound by filtration,

wherein said catalyst comprises at least one compound selected from the group consisting of alkali metal hydroxides and alkali metal alkoxides.

39. (Original) The method according to claim 38, wherein the alkyl acrylate is methyl acrylate.

40. (Original) The method according to claim 38, wherein the alkyl acrylate is a high molecular weight alkyl acrylate.

41. (Original) The method according to claim 40, wherein the high molecular weight alkyl acrylate is a C₂-C₁₀ alkyl acrylate.

42. (Original) The method according to claim 41, wherein the C₂-C₁₀ alkyl acrylate is a compound selected from the group consisting of n-butyl acrylate, sec-butyl acrylate, n-octyl acrylate, 2-ethylhexyl acrylate, isoheptyl acrylate, isooctyl acrylate, isononyl acrylate, isodecyl acrylate, and mixtures thereof.

43. (Previously presented) The method according to claim 38, wherein the hindered phenolic alkyl ester compound is formed in a liquid form.

44. (Original) The method according to claim 38, wherein the alkyl acrylate is reacted with the alkylphenol compound in the presence of an alcohol.

45. (Original) The method according to claim 44, wherein the alcohol is a high molecular weight alcohol.
46. (Original) The method according to claim 38, wherein the alkyl acrylate is reacted with the alkylphenol compound in the presence of a promoter.
47. (Previously Presented) The method according to claim 46, wherein the promoter comprises at least one compound selected from the group consisting of dialkyl sulfoxides, dialkyl formamides, dialkyl ethers, N,N-dialkyl acetamide, methyl ethyl ketone, methyl butyl ketone, phase transfer agents, crown ethers, and mixtures thereof.
48. (Original) The method according to claim 46, wherein the promoter is tetrahydrofuran.
49. (Previously Presented) The method according to claim 38, wherein the aqueous acid is orthophosphoric acid.
50. (Withdrawn) A composition produced according to the method of claim 1.
51. (Withdrawn) A composition comprising:
- a) 3,5-di-tert-butyl-4-hydroxyhydrocinnamic acid, C4-C10 alkyl ester, wherein the 3,5-di-tert-butyl-4-hydroxyhydrocinnamic acid, C4-C10 alkyl ester has a gas chromatogram within the composition of about 80.0% to about 98.0% by area,
 - b) pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] C1-C10 dialkyl ester, wherein the pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] C1-C10 dialkyl ester has a gas chromatogram within the composition of about 1.0% to about 20.0% by area, and
 - c) 3,5-di-tert-butyl-4-hydroxyhydrocinnamic acid, methyl ester, wherein the 3,5-di-tert-butyl-4-hydroxyhydrocinnamic acid, methyl ester has a gas chromatogram within the composition of about 0.1% to about 5.0% by area.

52. (Withdrawn) The composition of claim 51, wherein the 3,5-di-tert-butyl-4-hydroxyhydrocinnamic acid, methyl ester has a gas chromatogram within the composition of about 0.1% to about 1.0% by area.

53. (Withdrawn) The composition of claim 51, further comprising 2,6-di-tert-butylphenol, wherein the 2,6-di-tert-butylphenol has a gas chromatogram within the composition of about 0.1% to about 5.0% by area.

54. (Withdrawn) The composition of claim 53, wherein the 2,6-di-tert-butylphenol has a gas chromatogram within the composition of about 0.1% to about 1.0% by area.

55. (Withdrawn) The composition of claim 51, wherein the 3,5-di-tert-butyl-4-hydroxyhydrocinnamic acid, C4-C10 alkyl ester has a gas chromatogram within the composition of about 90.0% to about 97.0% by area,

the pentanedioic acid, 2-[[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] C1-C10 dialkyl ester has a gas chromatogram within the composition of about 1.5% to about 10.0% by area, and

the 3,5-di-tert-butyl-4-hydroxyhydrocinnamic acid, methyl ester has a gas chromatogram within the composition of about 0.1% to about 1.0% by area.

56. (Withdrawn) The composition of claim 51, wherein:

the 3,5-di-tert-butyl-4-hydroxyhydrocinnamic acid, C4-C10 alkyl ester has a gas chromatogram within the composition of about 95.0% to about 98.0% by area,

the pentanedioic acid, 2-[[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] C1-C10 dialkyl ester has a gas chromatogram within the composition of about 1.0% to about 2.5% by area, and

the 3,5-di-tert-butyl-4-hydroxyhydrocinnamic acid, methyl ester has a gas chromatogram within the composition of about 0.5% to about 1.0% by area.

57. (Withdrawn) The composition of claim 51, wherein

the 3,5-di-tert-butyl-4-hydroxyhydrocinnamic acid, C4-C10 alkyl ester is 3,5-di-tert-butyl-4-hydroxyhydrocinnamic acid, isooctyl ester,

the pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] C1-C10 dialkyl ester comprises pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] diisooctyl ester and pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] methyl isooctyl ester.

58. (Withdrawn) The composition of claim 51, wherein one of the alkyl ester groups of the pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] C1-C10 dialkyl ester is a C4-C10 alkyl ester.

59. (Withdrawn) The composition of claim 51, wherein the pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] C1-C10 dialkyl ester comprises at least one compound selected from the group consisting of:

pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] dibutyl ester, pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] bis(2-ethylhexyl) ester, pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] diisooctyl ester, and pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] diisooheptyl ester, and mixtures thereof, and

at least one compound selected from the group consisting of:
pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] methyl butyl ester, pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] methyl 2-ethylhexyl ester, pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] methyl isooctyl ester, pentanedioic acid, 2-[[3,5-di-tert-butyl-4-hydroxyphenyl]methyl] methyl isoheptyl ester, and mixtures thereof.

60. (Withdrawn) A product comprising the composition of claim 51 and at least one material selected from the group consisting of a lubricant oil, a dispersant, a detergent, an antiwear additive, a supplemental antioxidant, zinc dialkyldithiophosphate, an alkylated diphenylamine, a viscosity index improver, a pour point depressant, a corrosion inhibitor, a rust inhibitor, a foam inhibitor, a supplemental friction modifier, and mixtures thereof.

61. (Withdrawn) A product comprising the composition of claim 51 and at least one material selected from the group consisting of a lubricating oil, a detergent, a dispersant, zinc

dialkyldithiophosphate, a corrosion inhibitor, a rust inhibitor, an alkylated diphenylamine, and mixtures thereof.

62. (Withdrawn) A product comprising the composition of claim 51, a detergent, a dispersant, and zinc dialkyldithiophosphate.

63. (Withdrawn) The product of claim 62 further comprising a lubricating oil.

64. (Withdrawn) A product comprising the composition of claim 51, a corrosion inhibitor, a rust inhibitor, and an alkylated diphenylamine.

65. (Withdrawn) The product of claim 64 further comprising a lubricating oil.

66. (Withdrawn) The product of claim 61, wherein the detergent is present in an amount of about 1.0% to about 7.5% by weight of the product, the dispersant is present in an amount of about 1.0% to about 7.5% by weight of the product, the zinc dialkyldithiophosphate is present in an amount of about 0.5% to about 1.5% by weight of the product, and the composition of claim 52 is present in an amount of about 0.1% to about 2.0% by weight of the product.

67. (Withdrawn) The product of claim 64, wherein the corrosion inhibitor is present in an amount of about 0.01% to about 0.5% by weight of the product, the rust inhibitor is present in an amount of about 0.01% to about 0.5% by weight of the product, the alkylated diphenylamine is present in an amount of about 0.1% to about 1.0% by weight, and the composition of claim 52 is present in an amount of about 0.1% to about 1.0% by weight of the product.

68. (Withdrawn) The product of claim 60, wherein the lubricant oil is selected from the group consisting of passenger car engine oils, heavy duty diesel engine oils, railroad oils, natural gas engine oils, turbine oils, rust oils, oxidation oils, slideway oils, hydraulic oils, industrial oils, automotive gear oils, automatic transmission fluids and manual transmission

fluids, tractor fluids, universal tractor fluids, power steering fluids, gear lubricants, industrial oils, pump oils, and mixtures thereof.

69. (Currently amended) A method for the production of a hindered phenolic alkyl ester compound, said method consisting of:

~~a)~~ reacting an alkyl acrylate with a sterically hindered alkylphenol compound in the presence of a catalyst to form the sterically hindered phenolic alkyl ester compound,

forming a precipitated salt by steps consisting essentially of

- i) neutralizing the catalyst residue with an aqueous phosphoric acid, and
- ii) removing water to form a precipitated salt, and

separating the precipitated salt from the hindered phenolic alkyl ester compound by filtration,

wherein said catalyst comprises at least one compound selected from the group consisting of alkali and alkaline earth metal hydroxides and oxides, alkali metal hydrides, alkali metal alkoxides, alkali metal amides, zinc salts, calcium salts, monoalkyltins, alkali metal hydrocarbyloxides, and mixtures thereof.

70. (Currently amended) A method for the production of a hindered phenolic alkyl ester compound, which method comprises:

a) reacting methyl acrylate with a hindered phenolic compound in the presence of a first catalyst to form a methyl ester intermediate compound,

b) reacting an alcohol having at least 2 carbon atoms with the methyl ester intermediate compound in the presence of a second catalyst to form the hindered phenolic alkyl ester compound,

c) forming a precipitated salt by steps consisting essentially of

- i) neutralizing any catalyst residue with an aqueous phosphoric acid or phosphorous acid, and
- ii) removing water to form a precipitated salt, and

d) separating the precipitated salt from the hindered phenolic alkyl ester compound,

wherein said first catalyst and said second catalyst as charged to the reactor are the same and comprise at least one compound selected from the group consisting of alkali and alkaline earth

metal hydroxides and oxides, alkali metal hydrides, alkali metal alkoxides, alkali metal amides, alkali metal hydrocarboxides, and mixtures thereof.

71. (New) A method for the production of a sterically hindered phenolic alkyl ester compound, which method comprises:

- I) reacting an alkyl acrylate with a sterically hindered alkylphenol compound in the presence of an alcohol and a catalyst to form the sterically hindered phenolic alkyl ester compound,
- II) forming a precipitated phosphate salt by steps consisting essentially of
 - i) neutralizing any catalyst residue with an aqueous phosphoric acid, and
 - ii) removing water to form a precipitated phosphate salt, and
- III) separating the precipitated phosphate salt from the sterically hindered phenolic alkyl ester compound,

wherein said first catalyst and said second catalyst as charged to the reactor comprise at least one compound selected from the group consisting of alkali metal hydroxides, alkali metal alkoxides, and mixtures thereof.

72. (New) A method as in Claim 71 wherein the alkyl acrylate is methyl acrylate.

73. (New) A method as in Claim 71 wherein the alcohol is a high molecular weight alcohol.

74. (New) A method as in Claim 71 wherein the alkyl acrylate is reacted with the alkylphenol compound in the presence of a promoter.

75. (New) A method as in Claim 71 wherein the aqueous acid is orthophosphoric acid.